PB-215 112

REPORT ON SCIOTO RIVER STUDIES WINTER PERIOD, JANUARY 1954-FEBRUARY 1954

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

1954

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 215 112

REPORT

ON

SCIOTO RIVER STUDIES

WINTER PERIOD

January, 1954 – February, 1954

PREPARED BY THE
ROBERT A. TAFT SANITARY ENGINEERING CENTER
PUBLIC HEALTH SERVICE
AT THE REQUEST OF AND IN CO-OPERATION WITH THE
ATOMIC ENERGY COMMISSION

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. Department of Commerce
Springfield VA 22151

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
ROBERT A. TAFT
SANITARY ENGINEERING CENTER
CINCINNATI, OHIO

REPORT

ON

SCIOTO RIVER STUDIES

WINTER PERIOD

January, 1954 - February, 1954

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Center
Cincinnati, Ohio

1A

ACKNOWLEDGEMENT

The continued cooperation and assistance furnished by Federal, State and municipal agencies during the course of these studies are gratefully acknowledged.

Personnel of the Atomic Energy Commission were cooperative in providing liaison and other services.

The U. S. Geological Survey (Ohio District) and the U. S. Weather Bureau (Columbus and Cincinnati) furnished stream flow and drainage basin information and weather data.

Ohio Department of Health, Pike County Health Department, and Waverly municipal and water treatment plant personnel gave the Public Health Service survey team excellent cooperation in providing facilities and background information. The City of Waverly again provided a site for the mobile laboratory at the water treatment plant, water, electric power, and other courtesies.

The Ohio and Tennessee Drainage Basins Office, U. S. Public Health Service, supplied data and personnel to assist in performing the field studies.

TABLE OF CONTENTS

Acknowledgement	i
Table of Contents	ii
List of Tables and Figures	ii
Introduction	1
System of Sampling Point Designations	2
Scioto River Studies	3
Purpose of this Report	3
Summary and Conclusions	3
Section I. Sanitary Survey	7
Analyses Performed and Their Significance	9
Presentation of Data	10
Discussion - Water Quality	11
Section II. Spectrographic Studies	21
Section III. Carbon Filter Studies	25
References Cited	29

LIST OF TABLES AND FIGURES

Table		Follows Page
1	Location of Sampling Stations, Bridges, Tributaries, etc.	2
	Section I. Sanitary Survey	
2	Summary of Individual Results - Sanitary Examinations, 7-Day Consecutive Sampling Period	12
3	Results of Chlorination Studies, A.E.C. Water Intake	12
4	Summary of Individual Results - Sanitary Examinations, 24-Hour Sampling Period, February 3, 1954	12
5	Compilation of Mineral Analyses Data	12

TABLE OF CONTENTS (Cont'd)

Table		Follows Page
6	Summary of Miscellaneous Determinations, January-March, 1954	12
	Section II. Spectrographic Studies	
7	Semiquantitative Spectrographic Analysis of Metallic Constituents	24
	Section III. Carbon Filter Studies	
9	Groups Recovered from Total Organic Extract -Scioto River at A.E.C. Water Intake	28

Figure		
	Section I. Sanitary Survey	
1	General Reference Map, Scioto River Basin	2
2	Sanitary Examination - January-February, 1954, 7-Day Consecutive Sampling Period	12
3	Chlorination Studies	12
4	24-Hour Sampling Period - February 3, 1954, Station S-34.0 (A.E.C. Water Intake)	12

INTRODUCTION

The results of field studies conducted during the early fall of 1953 have been presented in a previous report. Findings of the study conducted under winter conditions are presented herein.

Low flow conditions prevailed continuously following the first survey and in mid-January it was decided to begin the second survey by the end of that month. At that time the flow was expected to be approximately twice that which was recorded on the first survey. Sampling was begun on January 26, 1954. Regular sampling was concluded on February 3, 1954.

The results of biological studies which have been conducted since the previous report will be presented in a separate report at a later date.

SYSTEM OF SAMPLING POINT DESIGNATION

A mileage index system is used to identify the location of sampling stations and important points on the Scioto River and its tributaries. This system involves the use of one or more letters to identify the stream, followed by a number which represents the distance in river miles from its mouth. In this report the letter "S" designates the Scioto River. For example, S-45.0 means that the station is located on the Scioto River 45.0 miles upstream from its mouth.

Each tributary to the Scioto River is designated by the first and second letters in its name. The first and second letters of the name of the tributary are preceded by the notation, "S-confluence mile." For example, S-62.5, Pa-1.5, would indicate that the station is located on Paint Creek 1.5 miles upstream from the confluence of Paint Creek and the Scioto River and that the point of confluence is 62.5 miles upstream from the mouth of the Scioto River.

The locations of sampling stations and other significant points on the Scioto River are listed in Table I.

TABLE I

SCIOTO RIVER STUDIES

LOCATIONS OF SAMPLING STATIONS, BRIDGES, TRIBUTARIES, ETC.

River Mile	Description of Station, Confluence, Etc.
S- 0	Confluence of Scioto River with Ohio River
S- 15.2	Lucasville Bridge, Route 348
S- 28.8	Approximate Location of A.E.C. Wells
S- 30.7	Piketon Sewer Outfall (approx.)
S- 30.8	Jasper Bridge, Route 124
S- 34.0	Sample Point #1, A.E.C. Intake Structure
S- 34.9	Piketon Bridge, Route U.S. 23
S- 37.9	Gravel Pit below Waverly
S- 38.6	Waverly Bridge, Route 220
S- 38.6	Waverly Sewer Outfall
S- 45.0	Sample Point #2, Omega Bridge, Route 335
S- 50.6	Salt Creek
S- 52.7	Approximate location of Miami Gravel Co.
S- 54.9	Sample Point #3, Higby Bridge
S- 62.5	Paint Creek
S- 63.4	Chillicothe Bridge, Route U.S. 35 & U.S. 50
S- 66.2	Chillicothe Sewer Outfall
S- 69.2	Chillicothe Bridge, Route U.S. 23
S- 76.2	Sample Point #4
S- 83.3	Deer Creek
S- 97.8	Circleville Sewer Outfall
S- 98.0	Circleville Bridge, Route U.S. 22
S- 99.0	Darby Creek
S- 104.2	Walnut Creek
S- 107.5	South Bloomfield Bridge, Route 316
S- 115.3	Big Walnut Creek
S- 118.1	Shadeville Bridge, Route 665
S- 125.2	Columbus Sewer Outfall
S- 126.0	Frank Road Bridge, Columbus
S- 130.6	Olentangy River

FIGURE 1

GENERAL REFERENCE MAP
SCIOTO RIVER BASIN

5 0 5 10
SCALE OF MILES

SCIOTO RIVER STUDIES

Purpose of Report

This report is based upon results of studies conducted in the winter of 1954 during a period of moderately low flow in the Scioto River (over twice the flow which occurred during the first survey). The principal purpose of this report is to present the additional findings of the winter survey.

Summary and Conclusions

Data regarding significant sources of pollution and existing water supplies in the Scioto River basin have been listed in the previous report. Samples from seven stations on the Scioto River including the water intake site were collected for seven consecutive days and analyzed for the common parameters of pollution. Samples from the river at the intake site were similarly collected and analyzed every two hours for a 24-hour period. Additional determinations were made on some of these samples to determine the quantities of fluoride and detergents present. Additional samples were collected from various points on the Scioto River and from several tributaries to obtain further information regarding the effects of industrial wastes and synthetic detergents on water quality. Special samples were collected for spectrographic, organic, and mineral analysis. Pertinent analyses were made on samples from the existing AEC wells.

In general data obtained during the winter study confirmed the previously presented conclusions in regard to the quality of the raw water at the AEC intake site. The river water was fairly high in mineral, organic and bacterial content. However, of equal or greater interest from a water

treatment standpoint was the rather wide day to day variation noted in certain of the constituents, notably the free ammonia content. The latter influences the chlorine required to produce a free chlorine residual and probably accounts for the wide variation in chlorine requirements indicated in Figure 3.

Water Quality

a. Bacteriological Quality - The Scioto River at the A.E.C. Intake site was significantly polluted from a bacterial standpoint at the flows encountered during the winter survey.

Coliform counts (MPN) per 100 ml. were highest at S-63.4 and S-54.9, below Chillicothe. Coliform counts at the intake site for this and the previous surveys are compared in the table which follows:

COMPARISON OF COLIFORM COUNTS

	1st Survey Sept.-Oct., 1953	2nd Survey Jan.-Feb., 1954
7-day sampling period		
Ave. Temperature, °C.	18	6
Ave. Discharge, cfs	318	885
Coliform Count (MPN) per 100 ml.		
Average	29,000	12,700
Median	23,000	9,300
Maximum	43,000	39,000
Minimum	9,300	2,300
24-hour sampling period		
Ave. Temperature, °C.	20	5
Ave. Discharge, cfs	302	585
Coliform Count (MPN) per 100 ml.		
Average	28,000	9,700
Median	23,000	9,300
Maximum	43,000	24,000
Minimum	9,300	2,300

b. Chemical Quality - The Scioto River at the AEC water intake site was still highly mineralized at the moderately low flows encountered during the winter survey. Total dissolved solids of 420 ppm were found in the composite sample taken on February 3, 1954. The total hardness was 275 ppm. Both total dissolved solids and total hardness were lower than during the previous survey.

The fluoride content of the river was below the 1.5 ppm level in all samples taken at the intake as would be expected at the flows which existed at the time. (Weekly samples by the Ohio Department of Health have indicated fluoride concentrations of approximately the same magnitude).

All other mineral constituents were below the maximum permissible or suggested limits for water supply purposes.

From 1.17 to 3.14 ppm of anionic detergent were found in the Scioto River at the intake site. Detergent concentrations in excess of 3-5 ppm may cause some water treatment plant difficulties.

Total and orthophosphates (which are found in most synthetic detergents) were found to correlate well with the detergents. Increases in the concentration of phosphate may increase taste and odor problems indirectly through the encouragement of algal growth. Lower concentrations of nitrite and nitrate nitrogen were found during the second survey. However, the concentration of ammonia was considerably higher than during the previous survey. In contrast to the decrease in concentration in the ammonia nitrogen from S-76.2 to S-34.0 during the first survey, the ammonia concentration was steady during this survey.

From 13 to 42 ppm of chlorine were required to produce a free chlorine residual. Eight to 12 ppm were required during the first survey. The amount of chlorine required for free residual chlorination was extremely high and

quite variable.

No significant changes in the chemical quality of the water from the AEC wells were observed. The water contains excessive amounts of iron and manganese and hardness all of which could be removed by conventional water treatment processes. As stated in the previous report treatment would be facilitated by the uniform nature of the well water.

c. Physical Quality - Water from the Scioto River at the AEC water intake still had significant color and turbidity during the second survey; however, both can be reduced to acceptable limits by appropriate water treatment measures.

Much lower odor numbers were recorded during the second survey. Median and maximum odor numbers were eight and 12, respectively, as compared to 96 and 256 during the first survey.

Water from the AEC wells had no apparent odor.

d. Spectrographic Studies - Spectrographic analysis of samples from the Scioto River at the AEC intake site and from the AEC wells indicated that the heavy metals were below the maximum allowable concentrations for finished waters.

e. Carbon Filter Studies - About 600 ppb of organic material were present in Scioto River water at the time of the winter survey as indicated by carbon filter extraction. This is essentially the same concentration that was found during the fall survey period and is approximately ten times the concentration found in water known to be of good taste and odor quality.

The well water was not sampled during the winter survey.

SECTION I. SANITARY SURVEY

ANALYSIS PERFORMED AND THEIR SIGNIFICANCE

Laboratory Tests - The routine laboratory tests included temperature, dissolved oxygen, biochemical oxygen demand, ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, color, turbidity, total suspended solids, total volatile suspended solids, pH, alkalinity and coliform MPN. Chlorine demand, free residual (break point) chlorination, chloride, total hardness, odor number, fluoride, detergents, and total and ortho-phosphates were also determined on selected samples. These determinations are the same as were performed on the previous survey and described in the previous report with the following exceptions:

(1) Total bacteria on agar at 37°C. determined on the first survey was omitted.

(2) Total and orthophosphateswere determined on selected samples. Orthophosphate was determined in the mineral analysis of the first survey.

(3) Free carbon dioxide was calculated for the samples taken from the wells and from the river at the intake during the 24-hour sampling period. (Free carbon dioxide was calculated for the well samples in the previous report).

Explanation of Laboratory Tests - An explanation of each analytical determination was given in the previous report as an aid in interpreting the results of the tests. Those tests which have been added are explained in the following sections. It was felt, on the basis of the results of the first survey, that the determination of total bacteria on nutrient agar in 24 hours at 37°C. did not add sufficient additional information to justify the time required on the analysis. All determinations, unless otherwise

Preceding page blank

indicated, were performed in accordance with Standard Methods for the Examination of Water and Sewage, Ninth Edition, 1946, of the American Public Health Association (1).

Total Phosphate - Total phosphate was determined in addition to orthophosphate determined on the previous survey. Phosphates in various forms are an important constituent of synthetic detergents. Phosphates may also occur in surface or ground waters (a) as a result of leaching from minerals or agricultural fertilizers, (b) as one of the stabilized products of decomposition of organic matter, (c) as a result of industrial wastes (several phosphate fertilizer plants are operating in the Columbus area), or (d) as a constituent of a water supply that has undergone phosphate treatment. Phosphate in the concentrations usually found in raw water sources has no physiological significance; it does, however, tend to encourage the growth of algae.

Free Carbon Dioxide - Free carbon dioxide was calculated from pH and alkalinity as indicated in Standard Methods for the Examination of Water and Sewage(1). Free carbon dioxide is significant in a water supply that is to be lime softened as it increases the amount of lime required. Excessive carbon dioxide may contribute to the corrosion of iron piping.

Changes in the free carbon dioxide content of a stream may be indicative of photosynthetic activity.

PRESENTATION OF DATA

The individual results of the sanitary examination of samples collected at S-34.0 (A.E.C. water intake), S-37.9 (gravel pit below Waverly), S-38.6 (Waverly Bridge), S-45.0 (Omega Bridge), S-54.9 (Higby Bridge), S-63.4 (U.S. 35 and U.S. 50 Bridge east of Chillicothe), and S-76.2 from January 26 to February 1, 1954, are presented in Table 2. The average results of selected

determinations at the seven stations are presented graphically in Figure 2. Results of chlorination studies are presented in Table 3 and in Figure 3.

Data from the examination of samples collected at 2-hour intervals during a 24-hour period on September 30, 1953, at the A.E.C. water intake are presented in Table 4. The results of selected determinations are presented graphically in Figure 4.

The results of mineral analyses of Scioto River water at S-34.0 (A.E.C. water intake) and of water from the A.E.C. wells are presented in Table 5. Results of previous analyses of water samples from these stations are also presented for comparison.

Results of miscellaneous tests on a number of samples collected during the survey are presented in Table 6.

DISCUSSION - WATER QUALITY

Coliform Bacteria - Median coliform values (MPN per 100 ml.) at the seven river stations sampled during the second survey at moderately low flow winter conditions for a 7 consecutive day period are shown in Figure 2. The average number of coliform bacteria (MPN) per 100 ml. at the A.E.C. water intake (S-34.0) was 12,700. Maximum and minimum values were 39,000 and 2,300, respectively. The median coliform values increased ten fold through the Chillicothe area from 4,300 at S-76.2 to 43,000 at S-63.4, below the Chillicothe primary treatment plant and above Paint Creek. MPN values dropped to 7,500 just above the Waverly outfall and continued to drop to 4,300 at S-37.9, seven-tenths of a mile below the Waverly outfall and 3.9 miles above the water intake. Coliform values increased to 9,300 at the intake. The increase between S-37.9 and S-34.0 may be due to normal sample variation, incomplete mixing, sampling of water containing wastes discharged at different times of the day

at Waverly and Chillicothe, or possibly to sewage discharged from individual sewage disposal systems in the Piketon area.

The average coliform count for the 24-hour sampling period was 9,700 per 100 ml. The mean, maximum and minimum values were 9,300, 24,000, and 2,300 respectively.

Color - The average color of the Scioto River at the intake was 24 ppm during the 7 consecutive day test. This is well below the value of 64 ppm recorded during the first survey. The color remained quite steady and averaged 48 ppm during the 24-hour sampling period on February 3, 1954. During the 24-hour sampling period on the previous survey the color remained steady throughout the day at 63 ppm.

It is probable that the color can be reduced to acceptable limits by appropriate water treatment.

Turbidity - The average turbidity of the river water at the intake site was 24 ppm* during the 7 consecutive day sampling period and 17 ppm during the 24-hour sampling period. The corresponding values for the first survey period were 38* and 36 ppm.

The turbidity of the samples taken on January 29 and 30, were not noticeably affected by the higher flows which occurred on those days. However, in general, the turbidity of the river would be expected to increase at the higher flows which result from high rates of surface runoff. A grab sample collected at the intake on March 24 when the flow was estimated to be 2400 cfs had a turbidity of 40 ppm. An estimated peak discharge of 2500 cfs passed the intake on

* Discounting the turbidity values reported or September 23, 1953, and January 26, 1954.

Environmental Health Center
U. S. Public Health Service
Cincinnati, Ohio

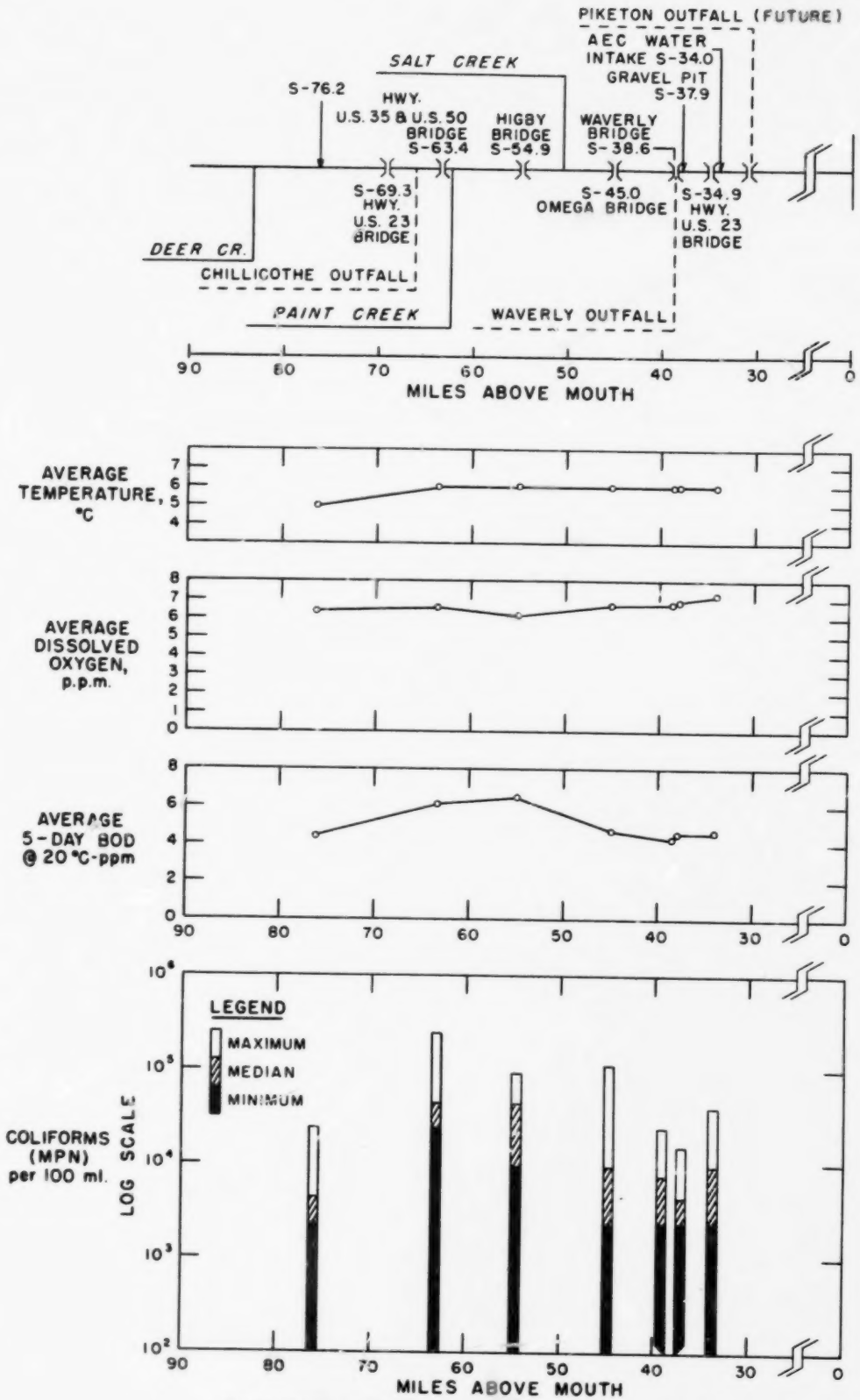
TABLE 2
SCIOTO RIVER STUDIES
SUMMARY OF INDIVIDUAL RESULTS - SANITARY EXAMINATIONS
7-DAY CONSECUTIVE SAMPLING PERIOD

Sample Station	Date 1954	Time	Flow	Temp.	Dissolved Oxygen		B.O.D. 5-Day 20°C.	Nitrogen			Color	Turbidity	Suspended Solids		Odor Number	Fluoride F^-	Chloride Cl^-	Total Hardness as $CaCO_3$	pH	Total Alkalinity as $CaCO_3$	Coliform Bacteria	Detergents (Commercial Product)	Phosphate PO_4^{---}	
								NH_3-N	NO_2-N	NO_3-N			Total	Volatile							MPN per 100 ml.		Ortho-	Total
		Hour	cfs	°C	ppm	% sat.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm		ppm	ppm	ppm		ppm		ppm	ppm	ppm
S-76.2	1/26	0840	412	10	6.7	59	5.7	2.6	0.066	0.14	40	45	38	15	-	-	32	-	7.8	198	24,000	-	-	-
	1/27	0810	383	7	8.5	85	4.9	2.1	0.075	0.13	55	30	14	7.5	-	0.96	-	-	7.7	195	9,300	1.9	1.1	1.9
	1/28	0805	663	3	9.1	88	5.8	2.6	0.09	0.66	75	25	18	8.0	-	-	26	296	7.7	204	2,300	-	-	-
	1/29*	0810	1,150	4	8.2	87	6.2	3.6	0.105	0.86	65	30	37	15	-	1.60	-	-	7.6	207	4,300	2.8	1.9	2.5
	1/30	0750	954	6	5.8	46	4.3	3.8	0.065	0.71	37	30	27	16	-	-	28	320	7.7	196	4,300	-	-	-
	1/31	0625	818	3	7.7	57	3.8	1.8	0.064	1.18	47	25	28	5.0	-	-	-	-	7.8	176	4,300	-	-	-
	2/1	0750	510	4	8.0	61	3.8	2.0	0.067	1.10	44	25	-	-	-	0.74	21	303	7.9	185	9,300	1.5	0.65	1.2
Average			699	5	6.4	50	4.9	2.6	0.076	0.68	52	30	27	11	-	1.10	27	306	-	194	4,300**	2.1	1.2	1.9
S-69.2	1/26	0905	412	13	6.1	58	7.2	3.4	0.063	0.76	-	-	-	-	-	-	31	-	-	-	24,000	-	-	-
	1/27	0855	383	7	6.6	58	6.6	2.4	0.065	0.14	-	-	-	-	-	0.94	-	-	-	-	93,000	2.1	1.4	2.2
	1/28	0850	663	3	6.5	48	6.5	2.4	0.072	0.68	-	-	-	-	-	-	29	226	-	-	240,000	-	-	-
	1/29	0850	1,150	4	6.4	49	6.2	2.5	0.091	0.84	-	-	-	-	-	1.30	-	-	-	-	43,000*	2.7	1.2	1.9
	1/30	0835	954	6	5.6	45	6.9	6.4	0.076	0.68	42	25	-	-	-	-	39	320	-	-	43,000	-	-	-
	1/31	0755	818	3	7.0	52	5.2	3.1	0.067	0.85	36	15	-	-	-	-	-	-	-	-	43,000	-	-	-
	2/1	0900	510	4	8.2	62	4.1	1.6	0.071	1.34	44	25	-	-	-	0.74	21	284	-	-	43,000	1.6	0.85	1.3
Average			699	6	6.6	53	6.1	3.1	0.072	0.76	-	-	-	-	-	0.99	30	297	-	-	43,000**	2.1	1.2	1.8
S-54.9 (Higby Bridge)	1/26	0935	574	12	6.8	63	4.7	4.0	0.087	0.44	35	40	36	16	-	-	30	-	7.9	205	93,000	-	-	-
	1/27	0930	560	8	5.1	43	9.0	2.2	0.055	0.12	55	50	26	10	-	0.74	-	-	7.7	198	23,000	1.8	1.2	1.8
	1/28	930	679	4	6.7	51	8.3	2.0	0.095	0.56	50	40	32	4.0	-	-	32	290	7.7	201	43,000	-	-	-
	1/29	0920	1,100	4	6.6	50	6.2	1.8	0.072	0.79	65	25	23	14	-	0.84	-	-	7.7	200	9,300	1.9	1.0	1.5
	1/30	0915	1,090	6	5.8	46	7.1	5.0	0.082	0.68	65	25	24	8.5	-	-	37	318	7.5	212	21,000	-	-	-
	1/31	0905	804	4	6.1	46	4.9	5.0	0.066	0.63	44	20	24	8.5	-	-	-	-	7.7	211	93,000	-	-	-
	2/1	0925	630	4	6.4	49	5.4	1.8	0.068	0.87	65	25	-	-	-	0.74	23	290	7.9	192	43,000	1.7	0.82	1.2
Average			777	6	6.2	50	6.5	3.1	0.064	0.58	54	32	28	10	-	0.77	30	302	-	203	43,000**	1.8	1.0	1.5
S-45.0 (Owego Bridge)	1/26	0830	630	13	6.3	59	5.1	4.8	0.050	0.34	50	35	30	6.0	-	-	30	-	7.8	195	24,000	-	-	-
	1/27	0820	625	9	7.2	68	4.5	3.2	0.045	0.48	40	30	24	9.0	-	1.04	-	-	7.7	185	43,000	2.1	1.4	2.1
	1/28	1000	690	3	6.0	45	4.9	1.9	0.052	0.12	50	30	28	10	-	-	27	284	7.7	170	9,300	-	-	-
	1/29	1000	1,070	4	7.0	64	4.3	1.4	0.057	0.63	37	25	19	12	-	0.62	-	-	7.8	177	9,300	1.6	1.0	1.2
	1/30	0945	1,030	6	6.6	52	5.4	2.3	0.071	0.66	60	25	27	11	-	-	26	284	7.7	192	2,300	-	-	-
	1/31	0940	850	4	6.9	53	4.3	4.8	0.070	0.61	49	15	18	2.0	-	-	-	-	7.7	200	9,300	-	-	-
	2/1	0950	680	4	6.6	50	4.6	3.2	0.068	0.63	38	20	-	-	-	1.14	31	295	7.8	190	110,000	2.5	1.4	1.8
Average			796	6	6.7	54	4.7	3.1	0.059	0.50	46	26	24	8.3	-	0.93	29	274	-	187	9,300**	2.1	1.3	1.7
S-38.6 (Waverly Bridge)	1/26	0900	645	13	6.7	63	5.4	4.4	0.050	0.31	-	-	-	-	-	-	30	-	-	-	21,000	-	-	-
	1/27	0900	630	9	7.4	70	4.8	4.1	0.044	0.58	-	-	-	-	-	1.36	-	-	-	-	4,300	2.4	1.6	2.4
	1/28	0840	700	7	6.2	51	3.9	2.6	0.050	0.10	-	-	-	-	-	-	28	253	-	-	7,500	-	-	-
	1/29	0945	1,050	4	6.6	50	4.4	1.4	0.054	0.60	-	-	-	-	-	0.62	-	-	-	-	2,300	1.3	0.82	1.3
	1/30	0815	1,020	4	7.0	53	4.5	2.0	0.070	0.67	-	-	-	-	-	-	26	272	-	-	2,300	-	-	-
	1/31	0935	880	4	6.5	50	3.7	4.2	0.073	0.67	-	-	-	-	-	-	-	-	-	-	24,000	-	-	-
	2/1	0815	710	4	7.0	53	3.6	4.4	0.071	0.60	-	-	-	-	-	1.36	35	296	-	-	24,000	3.3	1.8	2.1
Average			805	6	6.8	58	4.3	3.3	0.076	0.50	-	-	-	-	-	1.11	30	274	-	-	7,500**	2.3	1.4	1.9
S-37.9	1/26	0925	645	13	6.9	65	5.1	4.2	0.049	0.34	-	-	25	7.5	-	-	31	-	-	-	7,500	-	-	-
	1/27	0930	630	9	7.1	73	6.3	4.1	0.043	0.63	-	-	22	11	-	1.36	-	-	-	-	4,300	2.4	2.0	2.5
	1/28	0810	700	7	6.6	54	4.0	2.8	0.048	0.11	-	-	23	9.0	-	-	28	253	-	-	9,300	-	-	-
	1/29	0915	1,050	4	6.8	53	4.3	1.4	0.053	0.62	-	-	23	10	-	0.58	-	-	-	-	2,300	1.2	0.78	1.3
	1/30	0845	1,020	4	6.9	53	3.6	1.8	0.063	0.69	-	-	19	7.0	-	-	26	271	-	-	15,000	-	-	-
	1/31	0915	880	4	6.9	53	4.4	4.0	0.076	0.64	55	15	16	4.5	-	-	-	-	-	-	4,300	-	-	-
	2/1	0850	710	4	6.5	50	3.5	3.4	0.068	0.60	36	15	-	-	-	1.34	35	296	-	-	4,300	3.1	1.7	2.3
Average			805	6	6.9	56	4.5	3.2	0.057	0.52	-	-	21	8.2	-	1.09	30	273	-	-	4,300**	2.2	1.5	2.0
S-34.0 (At ABO Water Intake)	1/26	1010	654	13	7.5	71	6.2	3.9	0.047	0.38	65	140	261	43	4	-	30	-	7.9	187	39,000	-	-	-
	1/27	1015	638	8	7.5	63	6.1	4.3	0.040	0.60	50	35	38	14	12	1.42	-	-	7.7	192	15,000	2.3	1.7	2.4
	1/28	0950	700	7	7.3	60	4.1	2.9	0.043	0.092	50	30	16	4.5	4	-	26	250	7.9	176	9,300	-	-	-
	1/29	0830	1,040	3	6.9	51	3.9	1.4	0.052	0.63	50	25	17	2.5	8	0.58	-	-	7.6	167	2,300	1.4	0.85	1.3
	1/31	0930	1,010	4	7.2	55	3.7	1.7	0.055	0.69	60	25	16	5.0	8	-	26	267	7.7	184	4,300	-	-	-
	1/31	0830	900	4	7.2	55	4.6	3.2	0.069	0.75	46	15	19	2.5	8	-	-	-	7.7	194	15,000	-	-	-
	2/1	0935	730	4	7.1	54	3.8	4.5	0.068	0.65	40	15	-	-	6	1.16	35	296	7.8	200	4,300	3.1	1.8	2.3
Average			810	6	7.2	58	4.6	3.1	0.053	0.54	52	26***	21***	5.7***	8**	1.05	29	271	-	186	9,300**	2.3	1.4	2.0

*Sample taken at S-69.2.
**Median value instead of average value.
***Sample on 1/26/54 omitted.

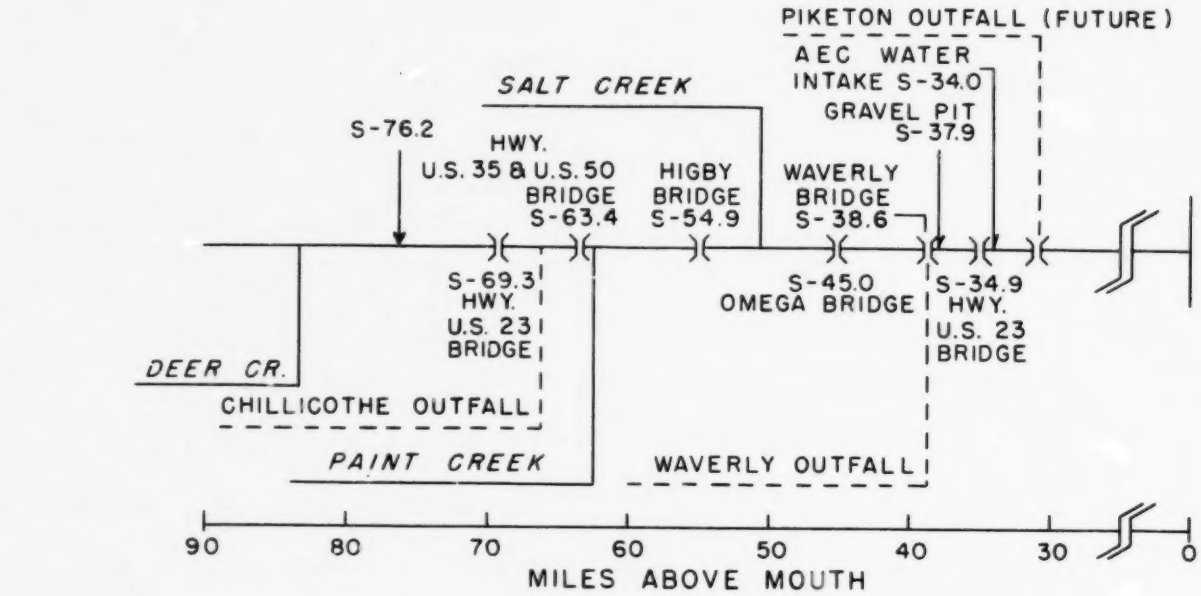
Note: Flows at S-45.0, S-38.6, S-37.9 and S-34.0 were estimated on the basis of the discharge at S-54.9 (Higby Bridge).

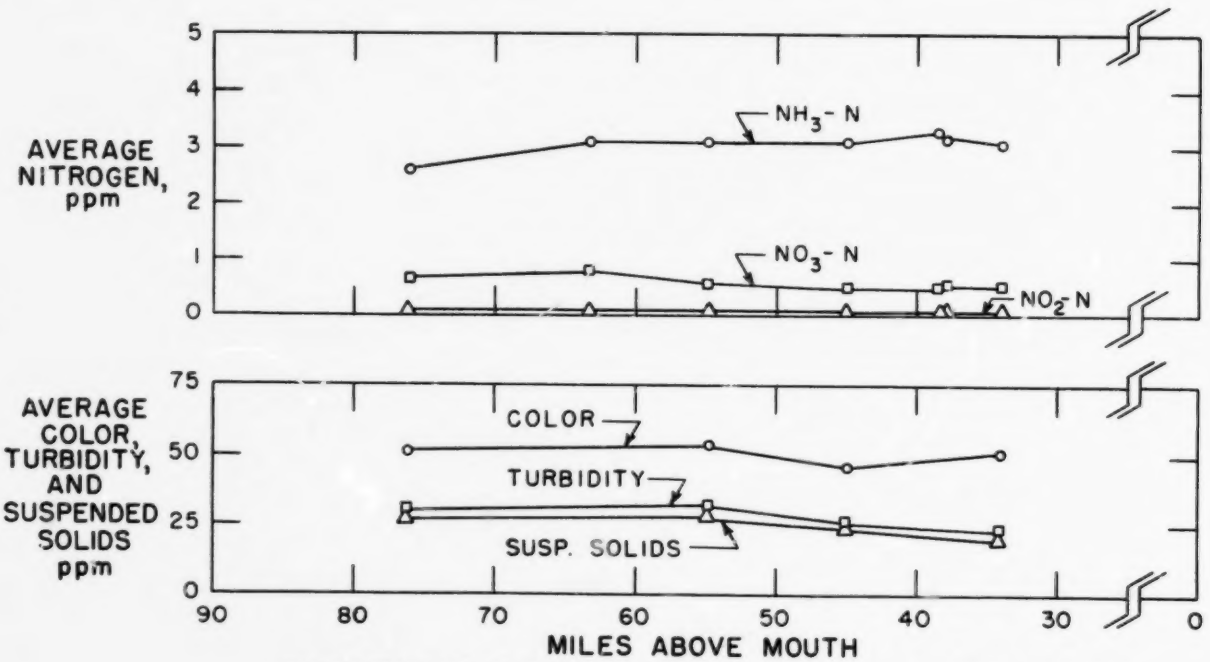
13-A



SANITARY EXAMINATION — JAN.—FEB., 1954
7-DAY CONSECUTIVE SAMPLING PERIOD
SCIOTO RIVER STUDIES

FIGURE 2





SANITARY EXAMINATION — JAN. — FEB., 1954
7-DAY CONSECUTIVE SAMPLING PERIOD
SCIOTO RIVER STUDIES

FIGURE 2 (CONT'D)

TABLE 3
SCIOTO RIVER STUDIES
RESULTS OF CHLORINATION STUDIES
A.E.C. - WATER INTAKE

FREE RESIDUAL CHLORINE

1/26/54
19° C., 30 min.

Chlorine Added	Chlorine Residual
4.43 ppm	3.66 ppm
11.1	10.2
22.2	19.2
26.6	20.0
28.8	17.1
31.0	2.71
33.2	3.86
35.4	5.77
39.9	9.41
44.3	14.1

1/28/54
13° C., 30 min.

Chlorine Added	Chlorine Residual
2.16 ppm	1.44 ppm
4.32	2.75
6.48	4.77
8.64	7.01
10.8	9.25
13.0	11.2
15.1	12.7
17.3	13.8
19.4	12.5
21.6	2.76
23.8	4.44
25.9	5.99
28.1	8.05
30.2	10.1
32.4	12.3
34.6	14.1

1/30/54
14° C., 30 min.

Chlorine Added	Chlorine Residual
3.64 ppm	2.57 ppm
7.28	6.21
9.10	7.41
10.9	7.74
12.7	2.78
14.6	2.66
16.4	4.35
18.2	6.17
20.0	7.39
21.8	9.52
25.5	12.8
29.1	16.0
32.8	19.6

2/1/54
16° C., 30 min.

Chlorine Added	Chlorine Residual
7.98 ppm	6.46 ppm
20.0	17.7
27.9	24.4
29.9	25.8
31.9	26.7
33.9	27.7
35.9	27.8
37.9	27.4
39.9	21.6
41.9	6.83
43.9	8.34
45.9	9.98
47.9	11.2
51.9	14.4
55.9	18.5
59.8	22.4

TABLE 3 (Cont'd)

2/3/54 (24 hr. comp.)
18° C., 30 min.

Chlorine Added	Chlorine Residual
3.42 ppm	2.40 ppm
6.84	5.34
8.55	6.30
10.3	6.19
12.0	2.86
13.7	2.06
15.4	3.35
17.1	4.77
18.8	6.34
20.5	7.61
22.2	9.21
23.9	10.4
27.4	13.5
30.8	16.6

CHLORINE DEMAND

Date 1954	Temp. °C.	Contact Time Min.	Chlorine Demand ppm
1/27	12	10	1.2
1/29	14	10	1.4
1/31	16	10	1.3
2/3 (24 hr. comp.)	19	10	1.3

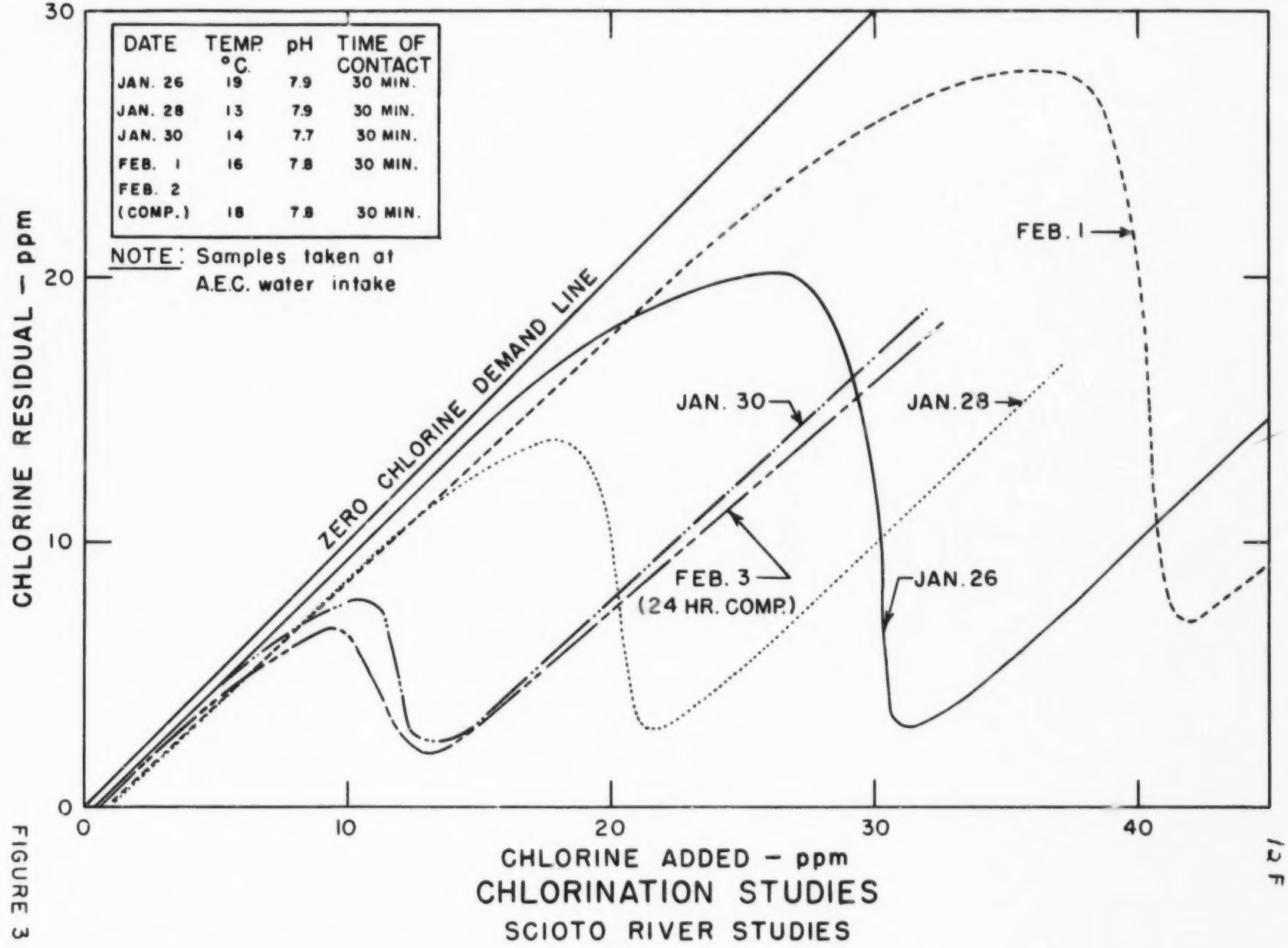

DATE | TEMP. °C. | pH | TIME OF CONTACT
JAN. 26 | 19 | 7.9 | 30 MIN.
JAN. 28 | 13 | 7.9 | 30 MIN.
JAN. 30 | 14 | 7.7 | 30 MIN.
FEB. 1 | 16 | 7.8 | 30 MIN.
FEB. 2 (COMP.) | 18 | 7.8 | 30 MIN.
NOTE: Samples taken at A.E.C. water intake
ZERO CHLORINE DEMAND LINE
FEB. 1
JAN. 30
JAN. 28
FEB. 3 (24 HR. COMP.)
JAN. 26
CHLORINE RESIDUAL – ppm
CHLORINE ADDED – ppm
0
10
20
30
40

FIGURE 3

CHLORINATION STUDIES

SCIOTO RIVER STUDIES

12 F

Environmental Health Center
U. S. Public Health Service
Cincinnati, Ohio

TABLE 4
SCIOTO RIVER STUDIES
SUMMARY OF INDIVIDUAL RESULTS - SANITARY EXAMINATIONS
24 HOUR SAMPLING PERIOD
February 3, 1954*

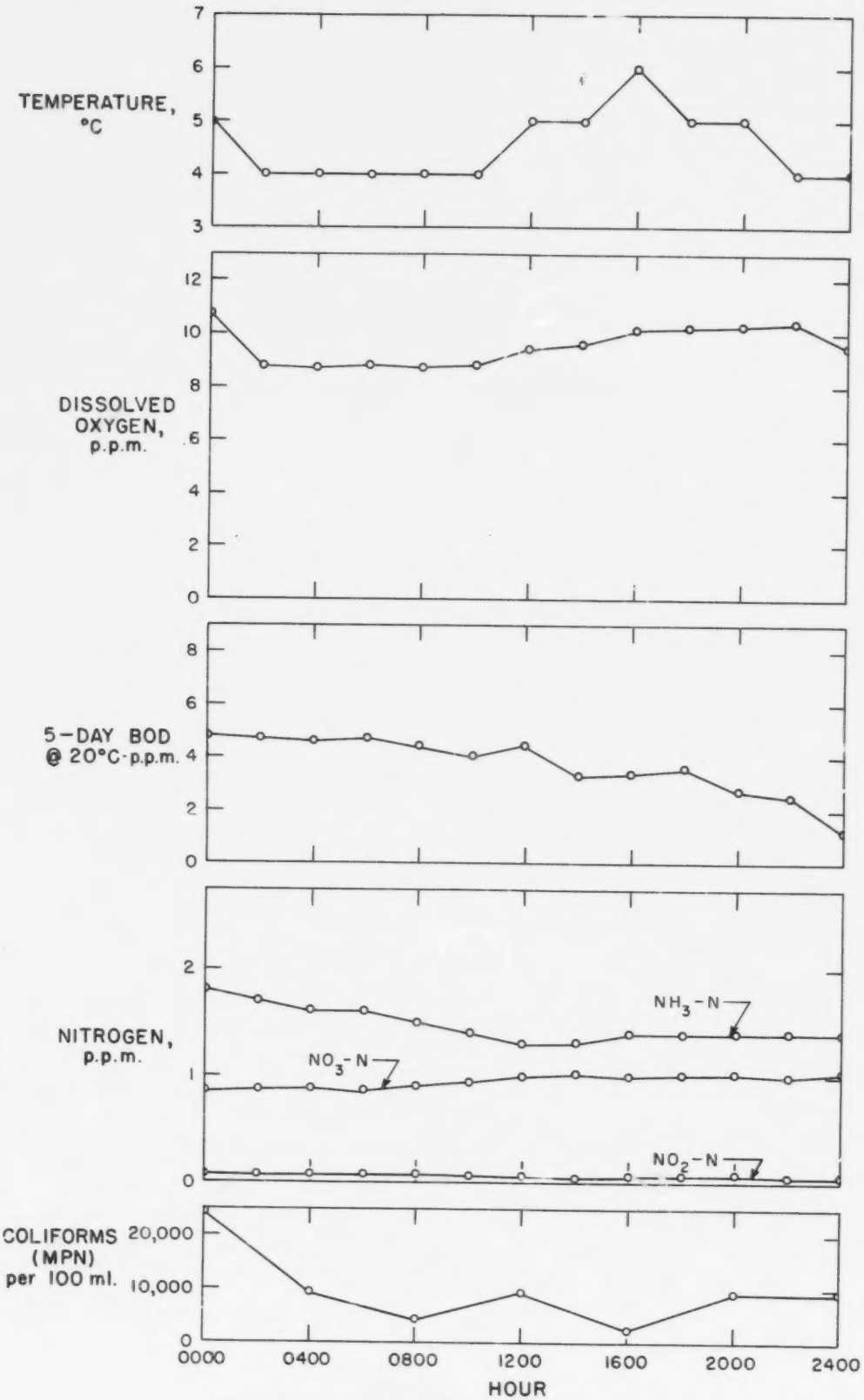
Time	Temp.	Dissolved Oxygen		B.O.D. 5-day 20° C.	Nitrogen			Color	Turbidity	Suspended Solids		Odor Number	Fluoride	Chloride	Total Hardness as $CaCO_3$	pH	Total Alkalinity as $CaCO_3$	Coliform Bacteria	Detergents (Commercial Product)	Phosphate PO_4	
					NH_3-N	NO_2-N	NO_3-N			Tot.	Vol.									Ortho-	Total
Hours	°C	ppm	% Sat.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm		ppm	ppm	ppm		ppm	MPN per 100 ml.	ppm	ppm	ppm
								S-34.0; A.E.C. WATER INTAKE													
0000	5	10.7	84	4.8	1.8	0.059	0.86	45	15	24	10	4	0.72	24	279	7.7	182	24,000	1.65	0.72	1.1
0200	4	8.8	67	4.7	1.7	0.054	0.89	-	-	-	-	-	-	-	-	7.7	-	-	-	-	-
0400	4	8.7	66	4.6	1.6	0.055	0.89	-	-	-	-	-	-	-	-	7.7	-	9,300	1.37	0.72	1.1
0600	4	8.8	67	4.7	1.6	0.055	0.86	49	15	17	9.0	-	0.66	23	276	7.8	183	(9,300)	-	-	-
0800	4	8.7	66	4.4	1.5	0.055	0.91	-	-	-	-	-	-	-	-	7.8	-	4,300	1.49	0.72	1.1
1000	4	8.8	67	4.0	1.4	0.052	0.95	-	-	-	-	-	-	-	-	7.8	-	(4,300)	-	-	-
1200	5	9.4	73	4.4	1.3	0.051	1.00	55	15	13	5.0	4	0.61	22	274	8.0	184	9,300	1.29	0.70	1.1
1400	5	9.6	75	3.3	1.3	0.047	1.02	-	-	-	-	-	-	-	-	7.9	-	-	-	-	-
1600	6	10.1	81	3.4	1.4	0.055	1.00	-	-	-	-	-	-	-	-	7.9	-	2,300	1.17	0.75	1.1
1800	5	10.2	80	3.6	1.4	0.056	1.02	49	15	21	4.6	-	0.60	20	273	7.9	182	-	-	-	-
2000	5	10.3	81	2.7	1.4	0.056	1.02	-	-	-	-	-	-	-	-	7.8	-	9,300	1.25	0.90	1.2
2200	4	10.4	80	2.5	1.4	0.051	1.00	-	-	-	-	-	-	-	-	7.8	-	-	-	-	-
2400	4	9.5	72	1.2	1.4	0.050	1.02	40	25	14	3.3	3	0.54	20	276	7.7	177	9,300	1.17	0.78	1.2
Avg.	5	9.5	74	3.7	1.5	0.054	0.96	48	17	18	6.4	-	0.63	22	276	-	182	9,300**	1.34	0.76	1.1
Max.	6	10.7	84	4.8	1.8	0.059	1.02	55	25	24	10	4	0.72	24	279	8.0	184	24,000	1.65	0.90	1.2
Min.	4	8.7	66	1.2	1.3	0.047	0.86	40	15	14	3.3	3	0.54	20	273	7.7	177	2,300	1.17	0.70	1.1
24-hr. Comp.	-	-	-	2.4	1.6	0.053	0.96	45	15	14	3.5	-	0.66	21	275	7.8	181	-	1.29	-	-

* Discharge at the Water Intake, estimated on the basis of the discharge at S-54.9 (Higby Bridge Gage), was 586 cfs.

** Median value instead of average value (The average of the tests made at 4-hour intervals is 9,700/100 ml.).

IRG

12-H



24 HOUR SAMPLING PERIOD — FEB. 3, 1954
STATION S-34.0 (A.E.C.-WATER INTAKE)
SCIOTO RIVER STUDIES

FIGURE 4

Environmental Health Center
U.S. Public Health Service
Cincinnati, Ohio

TABLE 5
SCIOTO RIVER STUDIES
COMPILATION OF MINERAL ANALYSES DATA
ANALYTICAL RESULTS IN PPM*

Source	(1) Scioto R. S-34.0 At AEC Water Intake	(2) Scioto R. S-34.0 At AEC Water Intake	(3) Scioto R. S-34.0 At AEC Water Intake	(4) AEC Wells	(5) AEC Wells	(6) AEC Wells
Date	2/3/54	9/24/53	9/30/53	2/4/54	10/6/53	9/7/53**
Time	24-Hr.comp.	1530	24-Hr.comp.	1315	1445	-
Discharge (cfs)	514 (A)	283 (A)	264 (A)	-	-	-
Color	45	-	65	-	-	0
pH	7.8	-	8.2	7.5	-	7.2
Silica SiO_2	9.5	6.3	10.8	9.8	9.9	9.0
Iron (Fe) (Filtered)	0.23	0.05	0.05	0.28	0.44	1.9
(Unfiltered)	0.49	-	-	1.56	-	-
Manganese (Mn) (Filt.)	0.07	<0.013	<0.013	0.15	0.13	0.26
(Unfiltered)	0.095	-	-	0.16	-	-
Calcium (Ca^{++})	61	87	86	68	85	76
Magnesium (Mg^{++})	25	28	31	39	29	34
Sodium (Na^{+})	16	8.9	18	4.3	2.3	4.4
Bicarb. (HCO_3^{-})	221	337	333	340	354	348
Sulfate (SO_4^{--})	114	105	120	51	51	48
Chloride (Cl^{-})	21	41	43	5.6	6.7	3.8
Fluoride (F^{-})	0.66	-	1.6	0.07	0.06	0
Nitrate (N)	0.096	0.2	2.5	0.03	0.09	0.3 ( )
Phosphate (PO_4^{---})	1.13	2.5	2.5	0.05	<0.01	-
Dissolved Solids	420	545	561	355	395	348
Suspended Solids	14	45	18	-	1.8	-
Vol. Susp. Solids	3.5	24	12	-	1.4	-
Free Carbon Dioxide	-	-	-	17.1	22.4	35
Hardness as $CaCO_3$						
Total	255	333	342	330	329	328
Carbonate	181	276	273	279	290	285
Non-Carbonate	74	57	69	51	39	43

* pH excepted
** Analyses by U.S. Geological Survey
(A) Discharge at Higby

TABLE 6
SCIOTO RIVER STUDIES
SUMMARY OF MISCELLANEOUS DETERMINATIONS
JANUARY-MARCH, 1954

Sampling Station	Date 1954	Time	Flow	Temp.	Dissolved Oxygen		BOD 20°C. 5-Day	Nitrogen			Color	Turbidity	Suspended Solids		Odor Number	Fluoride F^-	Chloride Cl^-	Total Hardness $CaCO_3$	pH	Total Alkalinity $CaCO_3$	Coliform Bacteria	Detergents (Commercial Product)	Phosphates PO_4	
								NH_3-N	NO_2-N	NO_3-N			Total	Vol.									Ortho-	Total
		hour	cfs	°C.	ppm	% Sat.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm		ppm	ppm	ppm		ppm	MPN per 100 ml.	ppm	ppm	ppm
S-34.0	2/9	1405	445	-	-	-	-	-	-	-	-	-	-	-	-	0.74	-	-	-	-	-	1.5	0.90	1.3
	3/24	-	2400	-	-	-	-	-	-	-	-	40	54	15	-	-	22	260	6.2	142	-	-	-	-
S-37.9	2/9	1320	440	-	-	-	-	-	-	-	-	-	-	-	-	0.74	-	-	-	-	-	1.6	0.98	1.4
S-38.6	2/9	1300	440	-	-	-	-	-	-	-	-	-	-	-	-	0.78	-	-	-	-	-	1.6	0.98	1.4
S-45.0	2/9	1220	430	-	-	-	-	-	-	-	-	-	-	-	-	0.72	-	-	-	-	-	1.6	1.1	1.5
S-54.9	2/9	1200	390	-	-	-	-	-	-	-	-	-	-	-	-	0.94	-	-	-	-	-	1.9	1.4	1.8
S-63.4	2/9	1145	286	-	-	-	-	-	-	-	-	-	-	-	-	1.02	-	-	-	-	-	2.7	2.5	2.9
S-76.2	2/9	1055	286	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-	-	-	-	-	2.8	1.8	2.1
S-96.0	2/9	1020	-	-	-	-	-	-	-	-	-	-	-	-	-	1.96	-	-	-	-	-	4.4	4.2	4.8
S-118.1	2/9	0950	-	-	-	-	-	-	-	-	-	-	-	-	-	2.56	-	-	-	-	-	11	3.9	4.9
S-126.0	2/9	0930	-	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-	-	-	-	-	2.2	2.2	3.1
S-50.6, Sa-1.4	2/5	1105	-	2	12.7	92.	0.71	0.27	0.0058	0.49	7.0	3	8.0	2.8	2	-	14.	107	7.7	72	-	-	-	-
S-50.6, Sa-8.4	2/5	1010	-	1	9.6	68.	0.79	0.16	0.0042	0.40	3.0	2	4.8	2.0	2	-	12.	144	7.7	104	-	-	-	-
S-62.5, Pa-1.5	2/5	0930	-	11	12.4	112.	57.9	0.68	0.0096	0.34	130	130	90	33	16	-	55.	324	8.7	240	-	-	-	-
S-62.5, Pa-3.1	2/5	0850	-	4	12.8	98.	0.67	0.16	0.006	0.17	4.0	3	9.5	5.0	2	-	9.9	267	8.1	217	-	-	-	-
AEC Wells																								
#1,2 & 3	2/5	1430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	7.5	278	-	-	-	-
#2	1/28	1020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	-	-	<2.1	-	-	-
	1/30	1015	-	13	-	-	-	0.20	0.0019	0.033	0	2	-	-	-	-	5.6	323	7.5	279	<2.1	-	-	-
	2/1	0955	-	13	-	-	-	-	-	-	3.0	2	-	-	-	0.14	—	330	7.5	261	<2.1	-	-	-
	2/3	1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.4	280	-	-	-	-
	2/4	1315	-	-	-	-	-	-	-	-	-	-	-	-	-	0.068	—	-	7.5	279	-	-	0.012	0.050
	2/8	0930	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	7.4	281	-	-	-	-
#3	2/5	1330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	7.5	270	-	-	-	-

March 23.

Rapid changes in the turbidity of raw water from the Scioto River are quite likely.

Turbidity can be removed by appropriate water treatment.

Nitrogen - During the 7 consecutive day sampling period the ammonia nitrogen content of the water at the intake averaged 3.1 with a minimum of 1.4 ppm and a maximum of 4.5 ppm.

In general, the ammonia, nitrite, and nitrate nitrogen decreased slightly down the stream. The average values of 3.1, 0.053 and 0.54 ppm, respectively, found at the intake, may be compared with values of 0.8, 0.08 and 0.98 found at that station during the first survey.

Free Residual Chlorination ("Breakpoint" Chlorination) - Water samples from station S-34.0 (A.E.C. water intake) required very large doses of chlorine to produce a free chlorine residual ("breakpoint"). Samples taken on January 26, 28 and 30 and February 1 and 3 required 31, 21, 13, 42 and 13 ppm of chlorine, respectively, to reach a free chlorine residual (See Figure 3). Chlorine applications of 9, 13, 10 and 10 ppm were required during the first survey period.

The quantity of chlorine required to effect a free residual or "breakpoint" is often considered to be approximately proportional to the amount of ammonia (NH_3) present in the water. Ammonia content of the water may prove to be a rough control parameter for applying chlorine. The chlorine-ammonia ratios observed on the two surveys were as indicated at the top of the next page:

CHLORINE-AMMONIA RATIO

Date	Discharge c.f.s.	"Breakpoint"* Cl2 ppm	Ammonia NH_3 ppm	Cl_2/NH_3
First Survey				
9/25/53	321	9	0.5	18
9/26/53	319	13	1.1	12
9/27/53	319	10	0.6	17
10/1/53 (24 hr. comp.)	302	10	0.84	12
Ave.	315	10.5	0.76	15
Second Survey				
1/26/54	664	31	3.9	8
1/28/54	774	21	2.9	7
1/30/54	1,200	13	1.7	8
2/1/54	718	42	4.5	9
2/3/54 (24 hr. comp.)	586	13	1.5	9
Ave.	788	24	2.9	8

* Chlorine dosage required to produce free residual chlorine.

Odor Number - The odor number at station S-34.0 (A.E.C. intake) varied during the 7-day sampling period from a minimum of 4 to a maximum of 12. It varied during the 24-hour period from 3 to 4. These values were substantially lower than were recorded during the previous survey.

Fluoride - Fluoride determinations made by the Public Health Service, by the Ohio Department of Health, and by the U. S. Geological Survey indicate that the fluoride concentration of the Scioto River is quite variable. Results of analyses of samples collected on January 27 and 29 and on February 1 during the 7-day sampling period are shown in Table 2. Samples taken at 6-hour intervals on February 3 showed some reduction through the day as indicated

on Table 4.

Water samples taken from the A.E.C. wells showed fluoride concentrations of 0.14 and 0.068 ppm during this survey and 0.13 ppm during the previous survey. Even under the drought conditions prevailing this past year there was no apparent infiltration of river water into the well supply as indicated by the relatively constant fluoride and chloride concentrations found on the two surveys.

Dissolved Oxygen - The average percent saturation values for dissolved oxygen at all sampling stations were between 50 and 58 percent during the 7-day sampling period. The low point in the oxygen sag curve was located around station S-54.9 as it was during the previous survey; the sag, however, was a small one. During the previous survey the dissolved oxygen was found to be exhausted at station S-54.9. Two major factors contributing to the improved conditions in the dissolved oxygen content of the river during this period as compared to the earlier survey period were the higher river flow and the much lower stream temperature.

No large diurnal variation in dissolved oxygen was noted during the 24-hour sampling period on February 3, 1954, at station S-34.0 (AEC Water Intake). Photosynthesis was not a significant factor during this survey period. In fact during the 24-hour sampling period higher dissolved oxygen values were recorded during the hours of darkness than during the daylight hours.

From the dissolved oxygen standpoint, the Scioto River appeared to have recovered substantially from the organic pollution load introduced farther upstream, during both survey periods. No problem with dissolved oxygen depletion is anticipated at the intake site.

Biochemical Oxygen Demand (5-day, 20° C. BOD) - The Biochemical Oxygen Demand values at the intake site during the second survey were slightly lower than those found during the previous survey. The BOD averaged 4.6 ppm for the 7-day sampling period at the water intake during the present survey as compared with an average value of 5.7 ppm during the summer sampling period. The average flow for this period was 885 cfs and for the earlier period was 318 cfs. The effects of the increased dilution afforded by the greater river discharge during the winter period was apparently offset by the influence of shorter flow times from the sources of pollution to the intake site resulting from higher flow.

On February 3, 1954, during a 24-hour sampling period at station S-34.0, the BOD varied from a minimum of 1.2 ppm to a maximum of 4.8 ppm and averaged 3.7 ppm (See Table 4 and Figure 4).

The average BOD for the 7-day sampling period at each of the seven stations are shown in Figure 2.

Water Temperature - Temperature data obtained on Scioto River water between 0800 and 1000 hours during the 7-day sampling period showed a significant change from January 26 to February 1. On January 26 the temperature was 13° C. while on February1 it was 4° C. This temperature change is a reflection of the change in air temperature. A diurnal temperature variation was still discernible at the 586 cfs flow estimated for the intake on February 3, 1954. The temperature ranged from 4°C. at night to 6° in midafternoon.

The stream temperature follows the air temperature changes fairly rapidly at low flows.

Total Hardness - Total hardness concentrations at the intake averaged 271 ppm for the three samples anaylsed during the 7-day test and 276 ppm for the five samples taken at 6-hour intervals for the 24-hour test. These values are

slightly lower than were recorded during the previous survey. Somewhat lower hardness values are to be expected at higher flows.

Total alkalinity was equal to carbonate hardness in all samples taken on the Scioto River. The expected total hardness can therefore be estimated very roughly as 1.15 to 1.5 times the total alkalinity.

The average total hardness of two well samples was 326 ppm. This is essentially the same as the value of 329 which was found on October 6, 1953, but is somewhat lower than the value of 350 which was found on December 3, 1953.

The total hardness of the well water should be quite constant. It should be amenable to lime softening, the control of which would be simplified by the uniform character of the well water.

Total Alkalinity - The total alkalinity varied slightly between sampling stations during the 7-day sampling period. The average value at the water intake was 186 and at Higby Bridge was 203. Total alkalinity (and therefore carbonate hardness) can be expected to decrease with increased flows. The lower alkalinity values observed on January 28 and 29 can be attributed to the increased flows on those dates.

Chloride - The chloride content of the stream on the four days sampled averaged between 27 and 30 ppm at the seven stations sampled. Chloride values observed at the intake ranged between 26 and 35 ppm. These values were markedly affected by the increased flow on January 28 and 29 and are below those observed on the previous survey.

Hydrogen Ion Concentration (pH) - The hydrogen ion concentration varied slightly at each sampling station during the 7-day sampling period. The pH ranged between 7.6 and 7.9.

During the 24-hour period on February 3, 1954, the pH varied between 7.7 and 8.0, as shown on Table 4, being lowest at night. These values are somewhat lower than were observed on the previous survey and are probably the result of decreased photosynthetic activity at the lower temperatures observed.

Free Carbon Dioxide (CO_2) - The free carbon dioxide content of Scioto River samples collected at the water intake structure during the 24-hour sampling run increased through the night on each of the surveys. The reduction in free CO_2 during the daylight hours was much greater during the first survey than during the second because of the greater amount of photosynthetic activity at the higher temperatures and lower flows which occurred during the first survey.

The free carbon dioxide content of the samples from the AEC wells was calculated from the pH and alkalinity data.

FREE CARBON DIOXIDE CONTENT OF A.E.C. WELL WATER

Well	Date	Hour	pH	Alk. ppm	Free CO_2 ppm
AEC wells*	9/7/53	-	7.2**	285**	35.
AEC wells*	10/6/53	1445	7.4	290	22.
No. 2	1/30/54	1015	7.5	279	17.
No. 2	2/1/54	0955	7.5	281	17.
No. 2	2/3/54	1700	7.4	280	22.
No. 2	2/4/54	1315	7.5	279	17.
No.1,2,& 3	2/5/54	1430	7.5	278	17.
No. 3	2/5/54	1330	7.5	270	17.
No. 2	2/8/54	0930	7.4	281	22.

* Number not known.
** These determinations by the U.S.Geological Survey, all other determinations by the U.S.Public Health Service.

These values indicate that the free carbon dioxide content of the well water is about 20 ppm. Aeration is seldom used for CO_2 removal below this concentration. Free CO_2 can be removed by lime treatment.

Mineral Analysis - The results of the mineral analyses of one sample each from the Scioto River and the A.E.C. wells are presented in Table 5. The results of past analyses by the U. S. Public Health Service for the low flow period of 1953 and by the U. S. Geological Survey during 1953 (2) are also presented in the same table for comparison.

As a consequence of the higher flows during the second survey, the river was less mineralized than during the period of the first survey. The concentration of mineral components confirmed, in general, the predictions made in the low flow period report; for example, the values of 21 ppm and 430 ppm for Chloride and Total Dissolved Solids, respectively, are almost exactly what would be obtained by reading the values from the curves in Figures 12 and 14 (previous report), respectively.

Synthetic Detergents - Synthetic detergents are rapidly attaining dominance as cleansers in industry and in the household. The national consumption is expected to exceed 2 billion pounds annually in the near future. In most industrial and domestic applications detergents eventually find their way into streams which may later be used as sources for potable water. The possibility of taste, odor, and coagulation problems arising from this source has aroused much general interest and considerable concern in some localities. Some work has indicated that as little as 3-5 ppm (possibly less) of detergent (the complete product as offered for retail or industrial sale) will interfere with coagulation and settling (3).

Phosphate compounds are also generally found in commercial detergents. The values for detergents (commercial product) and for phosphates found at the

A.E.C. water intake are indicated below:

DETERGENT AND PHOSPHATE RESULTS ABC INTAKE SITE

Date 1954	Time hour	Discharge at Intake Site cfs	Detergent (Commercial Product) ppm	Phosphate Ortho- ppm	Phosphate Total ppm
1/5	-	332	3.2	-	-
1/27	1015	638	2.3	1.7	2.4
1/29	0830	1040	1.4	0.85	1.3
2/1	0935	730	3.1	1.8	2.3
2/3	(24-hr.comp.)	586	1.3	0.72	1.1
	Max.		1.6	0.90	1.2
	Min.		1.2	0.70	1.1
2/9	1405	442	1.5	0.90	1.3

Foam, possibly caused by synthetic detergents, was observed on the Scioto River between Waverly and the intake site on numerous occasions.

SECTION II. SPECTROGRAPHIC STUDIES

SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSIS OF METALLIC CONSTITUENTS

One sample each from the Scioto River at the A.E.C. Water Intake (S-34.0) and from Well No. 2 of the A.E.C. wells were subjected to semi-quantitative spectrographic analysis to determine the concentrations of the trace metals listed in Table 8. The procedure used is outlined in the previous report. The results of these tests were essentially the same as were reported in the previous report, viz., that the concentrations of toxic heavy metals were low in all samples.

Selenium, which is not determinable by arc spectrographic analysis, was found by chemical analysis to be below 0.02 ppm in the river water sample.

Preceding page blank

TABLE 7

SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSIS OF METALLIC CONSTITUENTS
PARTS PER MILLION

Sampling Station / Element	Scioto River A.E.C. Water Intake S-34.0 24-Hour Composite 2/3/54	A.E.C. Wells (Well #2) 2/4/54	PHS Drinking Water Standard (Ref. 4) Finished Water
Antimony	<0.01	<0.01	-
Barium	0.05	0.025	-
Beryllium	<0.01	<0.01	-
Bismuth	<0.01	<0.01	-
Cadmium	<0.01	<0.01	-
Chromium	<0.01	<0.01	0.05*
Cobalt	<0.01	<0.01	-
Copper	0.03	0.01	3.0
Lead	0.01	0.01	0.1
Mercury	<0.01	<0.01	-
Molybdenum	0.1	0.005	-
Nickel	<0.01	<0.01	-
Tin	<0.01	<0.01	-
Titanium	0.002	<0.01	-
Tungsten	<0.01	<0.01	-
Vanadium	<0.01	<0.01	-
Zinc	<0.01	<0.01	15.0

* As hexavalent chromium.

SECTION III. CARBON FILTER STUDIES

Recovery of Organic Materials by the Carbon Filter Method from the Scioto River near Piketon, Ohio

The Scioto River at Piketon, Ohio, was sampled by the carbon filter method during the period from January 31 to February 4, 1954. The methods of sampling and analysis have been described in the previous report.

The recovery of organic materials from the winter period sample was similar to the fall (September 22-October 15, 1953) period sample. This was as follows:

Sample	Gallons Filtered	Recovery Grams	Recovery ppb
Fall Period	2800	6.23	587
Winter Period	1023	2.35	606

The separation of the organic extracts into groups is compared in Table 9. Certain losses occur in the separation of the groups. These losses may be due to volatiles, manipulative losses and other causes. The tabulation of the quantity recovered in each group as a percentage of the total quantity recovered in the group separation presents a more accurate comparison of the two samples. This comparison is made in the third column of Table 9.

The neutral materials in the winter period sample show a substantial increase as compared to the low flow period sample; the acidic materials show a decrease. This is interpreted as indicating a greater proportion of industrial materials in the winter sample, or that the oxidative processes have not taken place to the same extent as during the warmer weather. Decreased flow time may account in part for these results. The weak acid and phenol group had a rather distinct odor of wood tars and exhibited an

Preceding page blank

infrared spectrum of considerable more definition than the sample from the low flow period.

The general characterization of the odors of the groups are given in Table 9. Threshold odor tests were not made on this series of samples.

From the characteristics of the material recovered it is concluded that water from the Scioto River would probably cause serious taste and odor problems under the conditions of flow and organic content occurring at the time of the winter sampling period.

TABLE 9
GROUPS RECOVERED FROM TOTAL ORGANIC EXTRACT
SCIOTO RIVER AT A.E.C. WATER INTAKE

Group	Weight Recovered, Grams	Percent of Original Weight	Percent of Recovered Amounts	Characterization of Odors
		Fall Period		
Total Extract	-	-	-	Vegetable-Decay
Water Solubles	0.509	18.0	18.9	Caramel-Mild-Sweet
Amines (Bases)	0.101	3.6	3.8	Tobacco like
Weak Acids and Phenols	0.167	5.9	6.2	Wood Distillation Products
Strong Acids and Phenols	0.780	27.6	29.0	Rancid
Neutrals	1.133	40.1	42.1	Vegetable-Oily
Total Recovered	2.690	95.2	100.0	
		Winter Period		
Total Extract	-	-	-	Vegetable-Musty
Water Solubles	0.148	7.7	10.2	Caramel
Amines (Bases)	0.035	1.9	2.4	Tobacco
Weak Acids and Phenols	0.090	4.8	6.2	Wood Tars
Strong Acids and Phenols	0.164	8.7	11.3	Rancid
Neutrals	1.014	54.0	69.9	Oily
Total Recovered	1.451	77.1	100.0	

REFERENCES CITED

(1) Standard Methods for the Examination of Water and Sewage, 9th Ed. American Public Health Association, New York, p. 193 (1946).

(2) Lamar, William L., and Schroeder, Merle E., Chemical Character of Surface Waters in Ohio, 1946-1950, Bulletin 23. Ohio Department of National Resources, Division of Water, Columbus, Ohio (June, 1951).

(3) "Effect of Detergents on Sewage and Water Treatment." Chem. Eng. News, 31, 1072 (1953).

(4) "Public Health Service Drinking Water Standards." Public Health Rep., 61, 371-84. (1946). Reprint No. 2697.